

The Institute for Water & Watersheds Annual Technical Report FY 2015

Introduction

Oregonians are witnessing the difficulties caused by water limitations. Water quantity and quality issues in the Willamette, Klamath, Deschutes, and Umatilla Basins are the Governor's top environmental and water allocation priorities. This situation is paralleled around the world, and points toward a strong emerging area for growth in research, education, and outreach. These challenges are particularly relevant given that Oregon finished a statewide Integrated Water Resources Strategy – a first for the state – and is in the process of initiating a five-year review and update. A place-based approach to managing water resources is one of the principal strategies. A good example is the recently-signed Upper Klamath Basin Comprehensive Agreement, an accord that was negotiated and signed in 2014 by ranchers, tribes, and federal and state officials. U.S. senators from Oregon and California introduced legislation in 2015-2016 that focuses on restoring the Klamath Basin ecosystem, as well as enacting a water-sharing agreement.

Oregon State University is ideally positioned to assume a leadership role in addressing water problems, with about 125 faculty in six colleges who teach and conduct research in areas related to water and watersheds. OSU is renowned for its landscape-scale ecosystems research and continues to grow five new graduate degree programs in Water Resources. These research and education efforts have all occurred without the benefit of programmatic coordination or strategic vision.

Oregon's Water Institute, called the **Institute for Water and Watersheds (IWW)**, coordinates interdisciplinary research, education, and technology transfer on issues related to water and environmental sustainability. The IWW program assists faculty in providing outreach and research related to water resources issues on an "as-requested" basis. Partners and constituents include educational institutions, state and local governments, watershed councils, and the general public. While the IWW supports research through USGS funding, the new model for IWW is to support grant preparation as opposed to providing grants to facilitate research.

The IWW is involved in promoting the effective and sustainable use of water resources in the State of Oregon. IWW serves as a hub for water resources activities, for example:

- IWW is part of the OSU's Graduate Water Resources Graduate Program (<http://oregonstate.edu/gradwater/>).
- IWW operates and maintains a water collaboratory as a teaching lab for students and faculty.
- IWW funds graduate student hydrologic events such as an annual water symposium and field trips.
- IWW staff serve as expert "volunteers" to state agency advisory committees, county water committees, and local watershed councils.
- IWW initiates and coordinates transdisciplinary water resource research projects and through the USGS water institutes program, it funds seed grants on critical water issues for the state.
- IWW sponsors a regional water resources seminar each spring term on topics such as drinking water, stream restoration, water quality, and water conflict. Speakers from Oregon, the United States, and abroad participate in the program which has a different focus topic each year.
- Staff at IWW assist faculty at the state's institutions of higher education in research and outreach efforts related to its mission.

Staff resources continue on a part-time status. While the budget reductions have forced some re-defining of priorities within the IWW, it remains committed to the NIWR mission and providing research, education and outreach in water for the residents of Oregon. In many ways, these reductions have helped sharpen our knowledge of what is most critical in this regard and we are pursuing this with increased intensity with our world-class faculty in water within the Oregon higher educational system.

Research Program Introduction

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Oregon's Water Resources Research Institute, called the Institute for Water and Watersheds (IWW), coordinates interdisciplinary research, education, and technology transfer on issues related to water and environmental sustainability. The IWW program focuses on statewide water resources issues by assisting faculty within Oregon State University, as well as those located within neighboring Portland State University, University of Oregon, Western Oregon University, Oregon Institute of Technology, among many community colleges located across the state, to provide outreach and research related to water resources issues on an "as-requested" basis. Partners and constituents of include educational institutions, state and local governments, watershed councils, and the general public. While the IWW supports research through USGS funding, the model for IWW is to support grant preparation as opposed to providing grants to facilitate research.

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- IWW is part of the OSU's Graduate Water Resources Graduate Program (<http://oregonstate.edu/gradwater/>).
- IWW recently merged with OSU's Institute for Natural Resources.
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Research Program Introduction

The IWW is the hub for this diverse water research community. It seeks to solve complex water issues by facilitating integrative water research. The IWW's functions are to:

- Assemble diverse research teams and lead interdisciplinary and transdisciplinary water research projects.
- Help policy makers and water managers collaborate with university faculty and students.
- Offer training and access to water quality and stable isotope analysis facilities through a shared laboratory called the IWW Collaboratory.
- Encourage community and collaboration among water faculty, students and water managers by sponsoring events and producing a monthly statewide water newsletter.
- Assist water faculty with project development and management.

Why Focus on Water?

Oregon's economic vitality is directly tied to water. Water is “virtually” embedded in all Oregon products, from timber and salmon to solar panels and semiconductors. But water supply and demand in the state is changing. There is now less snowpack in mountain regions and the snow is melting earlier in the spring and summer. These changes have implications for irrigation, human consumption, hydropower generation and ecosystems. Shifting population, land use patterns and environmental policies will also influence the future supply and demand for abundant clean water. And the state of Oregon continues to develop an Integrated Water Resources Strategy, one of two western states that was without a strategic water plan until 2012, to prepare for climate change and the wave of anticipated “climate change refugees” from drier and hotter regions of the United States.

In the academic community there is growing recognition that the solutions to future water challenges lie not within a single discipline or subject but through the connection of concepts between multiple academic fields and through successful collaboration between academics and water managers. For example, anticipating the effect of climate change on Oregon's water resources requires not just the input of climatologists and hydrologists but also the perspective of many others from biologists and sociologists to water managers and policy experts.

Through an integrative research approach, the IWW seeks answers to questions important for Oregon, the nation and the world, such as:

- Where are climate change and human activity most likely to create conditions of water scarcity or an overabundance of water?
- Where is water scarcity or flooding most likely to exert the greatest impact on ecosystems and communities?
- What strategies would allow communities to prevent, mitigate, or adapt to scarcity and flooding most successfully?

Oregon State University hosts strong graduate degree programs in Water Resources and is located near state-of-the-art experimental watersheds and a suite of federal environmental laboratories. Below are short descriptions of some of the university's strengths in the areas of:

Research Program Introduction

- water science
- water engineering
- water policy and management
- water outreach and community education

Water Science

The OSU community has one of the largest gatherings of hydrologists and ecologists in the USA. They include not only campus faculty but also courtesy faculty from the suite of federal research laboratories located adjacent to campus. This combination makes for a world-class grouping of people, mapped against one of the strongest hydrological gradients (from the super-humid Oregon Coast to extreme aridity in Eastern Oregon) in the world. The campus is known for its transdisciplinary collaborations -- for example, faculty from the top-ranked forestry and conservation biology programs collaborating on salmon conservation studies. Many researchers take advantage of nearby field laboratories such as the NSF Long Term Ecological Research (LTER) facilities at the HJ Andrews Experimental Forest and industry timberland instrumented watersheds in the Oregon Coast range (Hinkle Creek, Alsea and Trask).

The OSU-Benton County Green Stormwater Infrastructure Research (OGSIR) Facility, a three-celled stormwater research facility for field-scale experiments and testing on green infrastructure (e.g., raingardens, bioswales, etc.), was completed in 2014. Stormwater Solutions, a film highlighting the creation of the OGSIR can be viewed at the following link (https://media.oregonstate.edu/media/t/0_03knf8eg).

Faculty from Oregon State University, the University of Oregon and Portland State University completed the final year of work on a five-year project funded by the National Science Foundation titled "Willamette Water 2100," a study that used Oregon's Willamette River basin as a test case for managing regional water supply. This project evaluated how climate change, population growth, and economic growth will alter the availability and the use of water in the Willamette River Basin on a decadal to centennial timescale.

Water Engineering

Unlike other land-grant institutions, OSU's engineering connection gives it strengths in treatment technologies for surface water, groundwater, and wastewater systems. OSU Engineering now ranks in the top 50 programs in the US. Many OSU engineers specialize in biological treatment methods and OSU hosts a Subsurface Biosphere Initiative that emphasizes interdisciplinary research on soil and groundwater microbial ecology. Many engineering faculty are also connected to the Oregon Built Environment & Sustainable Technologies Center (Oregon BEST) that connects the state's businesses with its shared network of university labs to transform green building and renewable energy research. Partnering with the OSU College of Business places a "business face" on the sustainability of engineered solutions to water problems. Before graduating, many engineering students enroll in coursework leading to a business savvy Entrepreneurship Minor.

Water Policy And Management

Addressing water resource challenges and reducing conflict in the US and abroad requires that water professionals and decision-makers receive specialized resources and skills that go beyond the traditional physical systems approach to water resources management. OSU offers a post-graduate certificate as part of their Program in Water Conflict Management and Transformation. The program leverages personnel from the top-10 nationally-ranked Geosciences Department, the top-five nationally ranked College of Forestry, as well as specialists in water policy, social science, communication, and anthropology. The "softer side" of OSU

Research Program Introduction

water has close links with UNESCO, the World Bank, the US Bureau of Reclamation and the US Army Corps of Engineers.

Peace Corps Masters International – Water

OSU was awarded the first PCMI with an emphasis in water resources in 2014. OSU recognizes that a partnership with the Peace Corps is also an ideal possibility to enhance our international and diversity focus even more. Many of the WRGP faculty are Returned Peace Corps Volunteers (RPCV). A Humanitarian Engineering program is also under development given the international focus of many faculty on campus. The first PCMI-Water student was assigned to Panama.

Joint Education Programme in Water Cooperation and Peace

UNESCO-IHE Institute for Water Education in the Netherlands, the University for Peace (UPEACE) in Costa Rica, and Oregon State University (OSU) in the USA, have embarked on a joint education program in Water Cooperation and Peace. The goal of this new initiative is to broaden the scope of approach to conflict and peace, provide a more theoretical dimension to conflict, engage multi-level scales of conflict dimensions and strengthen skills through highly experiential learning opportunities. The program will provide tools and training in an international setting, with a unique opportunity to undertake coursework and hands-on experiences in Costa Rica, The Netherlands and the United States. Participants will be exposed to case studies involving diverse challenges and contexts at different scales. The first student from the US has undertaken their studies in Costa Rica and the Netherlands and will finish their degree at OSU.

Supporting Near Real-Time Reservoir Dynamics Monitoring with USGS Satellite Data

Basic Information

Title:	Supporting Near Real-Time Reservoir Dynamics Monitoring with USGS Satellite Data
Project Number:	2015OR151S
USGS Grant Number:	
Sponsoring Agency:	U.S. Geological Survey
Start Date:	10/31/2015
End Date:	10/31/2016
Funding Source:	104S
Congressional District:	
Research Category:	Climate and Hydrologic Processes
Focus Category:	Surface Water, Models, Water Supply
Descriptors:	None
Principal Investigators:	Todd Jarvis

Publications

There are no publications.

Progress Report
Coordination Grant on
Supporting Near Real-Time Reservoir Dynamics Monitoring
with USGS Satellite Data

Opportunity Number: G15AS00001

Opportunity Name: USGS Non-Competitive Assistance FY 2015 - National Grants Branch

Jamon Van Den Hoek, vandenhj@oregonstate.edu

Progress to date has been composed of three stages. First, I have developed and refined an automated approach written in Python to generate a time series of surface area estimates at Lake Mead and Powell reservoirs using all available Landsat surface reflectance-corrected imagery collected since 1985. With this approach, effects of cloud cover and Landsat 7's Scan Line Corrector error are mitigated and extraneous water bodies within a given Landsat scene beyond the lake's extent are eliminated; the result is a reservoir body-specific time series. I am currently examining the potential value (i.e., ease of Landsat data access and management) and limitations (i.e., restrictions on analysis processing time) related to porting my Python approach to Google Earth Engine.

Second, I have compared various approaches to fuse Landsat-based surface area and ICESat GLAS-based surface elevation data in a spatiotemporally rigorous manner. With both datasets in hand, I have constructed reservoir-specific linear models relating surface area and elevation; these relationships are used to inform estimates of volumetric change based solely on spaceborne data. I have unsuccessfully attempted to develop collaborations with researchers skilled in processing ENVISAT radar altimetry data, data which would complement ICESat GLAS altimetry data, but continue to pursue such collaborations.

Third, I have begun building bathymetric models of Lake Mead and Powell reservoirs based on fused surface area and elevation datasets. These bathymetric models will be compared to existing very high resolution (<5m) digital bathymetric and topographic data to assess the accuracy of remote sensing-derived bathymetric model generation. Over the coming months, I will work with my USGS CIDA colleagues to finalize derived datasets and structure manuscripts for peer-review.

Information Transfer Program Introduction

OSU's reputation for providing vital environmental information to students and the public is beyond reproach. A few of OSU's water-related outreach programs include:

- **The Master Watershed Steward Program** - An OSU Extension program offering educational sessions and materials to help watershed groups and individuals understand how their watersheds work and apply this knowledge to watershed stewardship on their own land or in their community.
- **The Oregon Well Water Program** - An OSU Extension program designed to help Oregonians protect the groundwater that supplies their drinking water through education.
- **The Oregon Explorer Program** - An online digital library that provides natural resources information to decision makers through a growing series of Web portals.

Acknowledging that academics need to communicate research in different ways with policymakers, IWW has experimented with new ways to diversify our outputs. Gone are the days of simply sending academic journal articles to policy makers and staff. IWW now completes what is termed "just-in-time" white papers or short You-Tube videos on topics of interest.

Other Collaborative Activities

- The IWW Collaboratory use numbers keep climbing from a sample count of 2,250 in 2008 to 22,000. Number of users (departments, entities) totals over 60.
- The 5th Annual OSU Student Water Research Symposium put on by the Hydrophiles and the Water Resources Graduate Program and sponsored by IWW had over 152 attendees from 4 universities with 10 professional mentors over a three day period.
- The IWW Film Library has become famous and is used as a resource for the Environmental Conflict Resolution courses at the University of Oregon Law School located in Eugene, OR.
- IWW Director Todd Jarvis, in concert with the Water Resources Graduate Program and the Natural Resources Leadership Academy, has been working with the Falls City, OR since January 2013 to convene public meetings, listening sessions, and community mapping of potential solutions to surface and groundwater flooding associated with urban development and deforestation. The project is used by a graduate student for their research project and was presented at the 2016 National Ground Water Association Ground Water Summit in Denver, CO.

Technology Transfer

Basic Information

Title:	Technology Transfer
Project Number:	2015OR138B
Start Date:	3/1/2015
End Date:	2/28/2016
Funding Source:	104B
Congressional District:	OR-004
Research Category:	Climate and Hydrologic Processes
Focus Category:	Floods, Management and Planning, Law, Institutions, and Policy
Descriptors:	None
Principal Investigators:	Todd Jarvis

Publications

1. 2016 Publications

- ◆ Chaffin BC, Garmestani AS, Gosnell H, Craig RK. 2016. Institutional networks and adaptive water governance in the Klamath River Basin, USA Environmental Science and Policy
- ◆ Fierro P, Quilodrán L, Bertrán C, Arismendi I, Tapia J, Peña-Cortés F, Hauenstein E, Arriagada R, Fernández E, Vargas-Chacoff L. 2016. Rainbow Trout diets and macroinvertebrates assemblages responses from watersheds dominated by native and exotic plantations Ecological Indicators
- ◆ Fleming SW, Hood E, Dahlke HE, O'Neel S. 2016. Seasonal flows of international British Columbia-Alaska rivers: The nonlinear influence of ocean-atmosphere circulation patterns Advances in Water Resources
- ◆ Safeeq M, Grant GE, Lewis SL, Staab B (2015) Predicting landscape sensitivity to present and future floods in the Pacific Northwest, USA Hydrological Processes
- ◆ González-Pinzón R, Peipoch M, Haggerty R, Martí E, Fleckenstein JH. 2016. Nighttime and daytime respiration in a headwater stream Ecohydrology
- ◆ Mildrexler D, Yang Z, Cohen WB, Bell DM. 2016. A forest vulnerability index based on drought and high temperatures Remote Sensing of Environment
- ◆ Newton M, Ice G. 2016. Regulating riparian forests for aquatic productivity in the Pacific Northwest, USA: addressing a paradox Environmental Science and Pollution Research
- ◆ Robinne F-N, Miller C, Parisien M-A, Emelko M, Bladon K, Silins U, Flannigan M. 2016. A Global Index for Mapping the Exposure of Water Resources to Wildfire Forests

2. 2015 Publications

- ◆ Bailey A, Noone D, Berkelhammer M, Steen-Larsen HC, Sato P. 2015. The stability and calibration of water vapor isotope ratio measurements during long-term deployments. Atmospheric Measurement Techniques. 8(10):4521-4538.
- ◆ Bartz KK, Ford MJ, Beechie TJ, Fresh KL, Pess GR, Kennedy RE, Rowse ML, Sheer M. 2015. Trends in Developed Land Cover Adjacent to Habitat for Threatened Salmon in Puget Sound, Washington, U.S.A.. PLOS ONE. 10(4):e0124415.
- ◆ Beagle JR, Kondolf GM, Adams RM, Marcus L. 2015. Anticipatory Management for Instream Habitat: Application to Carneros Creek, California. River Research and Applications. 32(3):280-294.
- ◆ Becker B, Galhardo BDOS, Macedo DR, Hughes RM, Callisto M, Santos GB. 2015.

Technology Transfer

Influence of limnological zones on the spatial distribution of fish assemblages in three Brazilian reservoirs. *Journal of Limnology*.

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- ◆ Berner LT, Law BE. 2015. Water limitations on forest carbon cycling and conifer traits along a steep climatic gradient in the Cascade Mountains, Oregon *Biogeosciences*
- ◆ Bhomia RK, Inglett PW, Reddy KR. 2015. Soil and phosphorus accretion rates in sub-tropical wetlands: Everglades Stormwater Treatment Areas as a case example. *Science of The Total Environment*. 533:297-306.
- ◆ Buss DF, Carlisle DM, Chon T-S, Culp J, Harding JS, Keizer-Vlek HE, Robinson WA, Strachan S, Thirion C, Hughes RM. 2015. Stream biomonitoring using macroinvertebrates around the globe: a comparison of large-scale programs. *Environmental Monitoring and Assessment*. 187(1)
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- ◆ Clark MP, Nijssen B, Lundquist JD, Kavetski D, Rupp DE, Woods RA, Freer JE, Gutmann ED, Wood AW, Gochis DJ et al.. 2015. A unified approach for process-based hydrologic modeling: 2. Model implementation and case studies. *Water Resources Research*. 51(4):2515-2542.
- ◆ Crook DA, Lowe WH, Allendorf FW, Erős T, Finn DS, Gillanders BM, Hadwen WL, Harrod C, Hermoso V, Jennings S et al.. 2015. Human effects on ecological connectivity in aquatic ecosystems: Integrating scientific approaches to support management and mitigation. *Science of The Total Environment*. 534:52-64.
- ◆ Davis LJ, Reiter M, Groom JD. 2015. Modelling temperature change downstream of forest harvest using Newton's law of cooling. *Hydrological Processes*. 30(6):959-971.
- ◆ Emelko MB, Stone M, Silins U, Allin D, Collins AL, Williams CHS, Martens AM, Bladon KD. 2015. Sediment-phosphorus dynamics can shift aquatic ecology and cause downstream legacy effects after wildfire in large river systems. *Global Change Biology*. 22(3):1168-1184.
- ◆ Evaristo J, Jasechko S, McDonnell JJ. 2015. Global separation of plant transpiration from groundwater and streamflow. *Nature*. 525(7567):91-94.
- ◆ Faramarzi M, Srinivasan R, Iravani M, Bladon KD, Abbaspour KC, Zehnder AJB, Goss GG. 2015. Setting up a hydrological model of Alberta: Data discrimination analyses prior to calibration. *Environmental Modelling & Software*. 74:48-65.
- ◆ Febria CM, Hosen JD, Crump BC, Palmer MA, Williams DD. 2015. Microbial responses to changes in flow status in temporary headwater streams: a cross-system comparison. *Frontiers in Microbiology*.
- ◆ Ferreira WR, Ligeiro R, Macedo DR, Hughes RM, Kaufmann PR, Oliveira LG, Callisto M. 2015. Is the diet of a typical shredder related to the physical habitat of headwater streams in the Brazilian Cerrado? *Annales de Limnologie - International Journal of Limnology*. 51(2):115-127.

Technology Transfer

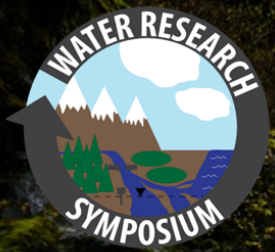
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- ◆ Frans C, Istanbuluoglu E, Lettenmaier DP, Naz BS, Clarke GKC, Condom T, Burns P, Nolin AW. 2015. Predicting glacio-hydrologic change in the headwaters of the Zongo River, Cordillera Real, Bolivia *Water Resources Research*
- ◆ Frans C, Istanbuluoglu E, Lettenmaier DP, Naz BS, Clarke GKC, Condom T, Burns P, Nolin AW. 2015. Predicting glacio-hydrologic change in the headwaters of the Zongo River, Cordillera Real, Bolivia. *Water Resources Research*. 51(11):9029-9052.
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- ◆ Good SP, Noone D, Bowen G. 2015. Hydrologic connectivity constrains partitioning of global terrestrial water fluxes. *Science*. 349(6244):175-177.
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- ◆ Gregg T, Prah FG, Simoneit BRT. 2015. Suspended particulate matter transport of polycyclic aromatic hydrocarbons in the lower Columbia River and its estuary. *Limnology and Oceanography*. 60(6):1935-1949.
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Technology Transfer

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 - ◆ Petersen-Perlman JD, Wolf AT. 2015. Getting to the First Handshake: Enhancing Security by Initiating Cooperation in Transboundary River Basins. *JAWRA Journal of the American Water Resources Association*. 51(6):1688-1707.
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 - ◆ Safeeq M, Grant GE, Lewis SL, Staab B. 2015. Predicting landscape sensitivity to present and future floods in the Pacific Northwest, USA *Hydrological Processes*
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6th Annual

Pacific Northwest Water Research Symposium

hosted by the OSU Hydrophiles

Photo by Lucas Rietmann

ALL EVENTS HELD AT THE CH2M HILL ALUMNI CENTER

SYMPOSIUM

SCHEDULE

MONDAY APRIL 18

7:30 am *Check-in and breakfast*

8:00 am **ORAL PRESENTATIONS**

8:00 am Welcome

8:15 am-10:00 am A Changing Climate

10:15 am-12:00 pm Watershed Management

All presentations in Cascade Ballroom

12:00 pm **LUNCH**

provided for registered attendees

1:00 pm **WORKSHOPS ROUND I**

Water Conflict Mgmt. and Transformation

Water Law for Scientists and Engineers

Communicating through Stories and Film

Connecting with Stakeholders in Restoration

3:00 pm **MENTORING SESSIONS**

4:45 pm **NETWORKING RECEPTION**

5:30 pm **KEYNOTE ADDRESS**

Dr. Robert Lackey

Scientists, Engineers, and Policy Advocates:

Delineating Appropriate Roles in Public Policy

TUESDAY APRIL 19

7:30 am *Check-in and breakfast*

8:00 am **WORKSHOPS ROUND II**

Serious Gaming in Water Resources

Modeling for Non-Modelers

Visualizing Boundary Layer Meteorology

10:00 am **POSTER PRESENTATIONS**

10:00- 11:00 am Poster Session A

Cascade Ballroom- North

11:00 am- 12:00 pm Poster Session B

Cascade Ballroom- South

12:00 pm **LUNCH**

provided for registered attendees

1:00 pm **ORAL PRESENTATIONS**

1:00 pm- 2:30 pm Toxins and Turbulence

Cascade Ballroom- North

1:00 pm- 2:30 pm Hydro-Human Harmony

Cascade Ballroom- South

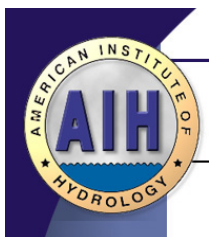
2:45 pm **WORLD CAFÉ**

4:15 pm **CLOSING REMARKS**

2016

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Donations from Dr. Todd Jarvis, Dr. Michael Campana

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OSU/PSU Collaborative Clackamas Watershed Tour

*presented by
the Clackamas River Providers*

On February 6, 2016, graduate students of Portland State University and Oregon State University joined together to take an in-depth look at the integrated water management within the Clackamas River Basin with transportation generously funded by the **Institute for Water and Watersheds**.

We began at the **North Clackamas County Water Commission Water Treatment Center**, which currently services 300,000 residents in the area. **Christine Hollenbeck** and **Joe Rogers** demonstrated the plant's gravity filtration system and its supplementary membrane filtration system, a state-of-the-art process that can provide up to 20,000 gallons per day for the area's residents. These systems are carefully maintained to adapt and provide high quality water during any river flow condition.



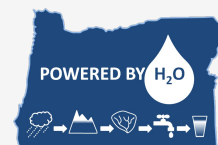
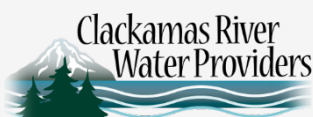
Our second stop was the **Portland General Electric (PGE) Clackamas River Hydroelectric Project** in Estacada, Oregon. **John Esler** and **Tim Shibahara** led the group through the River Mill Dam, the Faraday Dam and Powerhouse and the North Fork Dam system where discussion ranged from fisheries management to collaboration, stakeholder investment, and ingenuity for finding sustainable solutions to balance resource protection and power needs into the future. The Clackamas watershed serves as a cornerstone in salmon restoration and the Faraday Dam's salmon diversion system is a one-of-a-kind facility that allows for adaptive management of salmon populations and both up and down stream fish passage on the Clackamas River.



The final stop of the tour was a drive up the headwaters of the **USFS Clackamas River Ranger District** to where the Collawash River meets the Clackamas River. USFS Fisheries Biologist, **Tom Horning**, led discussion on source water protection and watershed management. This final stop emphasized the themes of the day and how diverse user groups can be effectively brought together within the unique natural system of the Clackamas River through the continuous work of many dedicated individuals.



A SPECIAL THANKS TO

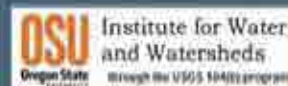




Water Resource Graduate Program

Winter 2016 Seminar Series:

Perspectives Across the Hydrologic Cycle



- Jan 6** *The influence of sediment transport dynamics on benthic primary production in mountain headwater streams*
Scott Katz, Oregon State University: Water Resource Science Graduate Program
- Jan 13** *Bubble trouble: understanding links between water management and methane emissions in Pacific Northwest reservoirs*
John Harrison, Washington State University, Vancouver: School of the Environment
- Jan 20** *Quantifying ecosystem water use through evapotranspiration partitioning*
Stephen Good, Oregon State University: Biological & Ecological Engineering Department
- Jan 27** *Hydroinformatics for Integrated Water Management*
Meghna Babbar-Sebens, Oregon State University: School of Civil and Construction Engineering & Co-director of OSU-Benton County Green Stormwater Infrastructure (OGSIR) Facility
- Feb 3** *Scale of flow field observation influences apparent velocity use and energy expenditure in juvenile coho salmon*
Desiree Tullos, Oregon State University: Biological & Ecological Engineering Department
- Feb 10** *How above-ground forest structure and below-ground water storage interact to determine forest sensitivity to changes in climate and forest management practices*
Naomi Tague, University of California, Santa Barbara: Bren School of Environmental Science & Management
- Feb 17** *Tracers applied to groundwater mixing: karst aquifers and Puget Sound research*
Andrew Long, U.S. Geological Survey (USGS), Tacoma, WA
- Feb 24** *Sediment transport modelling*
Catalina Segura, Oregon State University: Department of Forest Engineering, Resources, and Management
- Mar 2** *Combining in situ and remotely sensed data to understand the interactions between forests and water in the Sierra Nevada*
Mohammad Safeeq, Sierra Nevada Research Institute & University of California-Merced: School of Engineering
- Mar 9** *Bathymetry and Coastal Change Assessment from Airborne and Spaceborne Sensors*
Chris Parrish, Oregon State University: School of Civil & Construction Engineering

Peavy 101
Wednesdays
4-5 PM

Students can enroll for credit:

- Seminar WRE 507 (CRN 35202)
 - Journal Club WRE 505 (CRN 33439)
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Accommodations for disabilities may be made by calling
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WATER LAW BOOT CAMP

A WORKSHOP DESIGNED SPECIFICALLY FOR THE OREGON STATE UNIVERSITY WATER RESOURCES COMMUNITY

Laura Schroeder, Attorney at Law

A course in Water Policy and Law was offered first in 2004 by former Institute for Natural Resources Director Gail Achterman, Meg Reeves, and John Selker, and has not been offered since the untimely passing of Gail in January 2012.

In recognition of the restarting this important training at OSU, Laura Schroeder has generously consented to offer her famous “Water Rights Boot Camp” – a three hour seminar developed in part with the NGO – Water For Life. Laura has not offered “boot camp” for several years but is willing to offer a version to OSU in 2016 for free.

Thursday

February 25, 2016

2-5 P.M.

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~~Wilkinson Hall Room 207~~

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Refreshments provided so please RSVP iww@oregonstate.edu

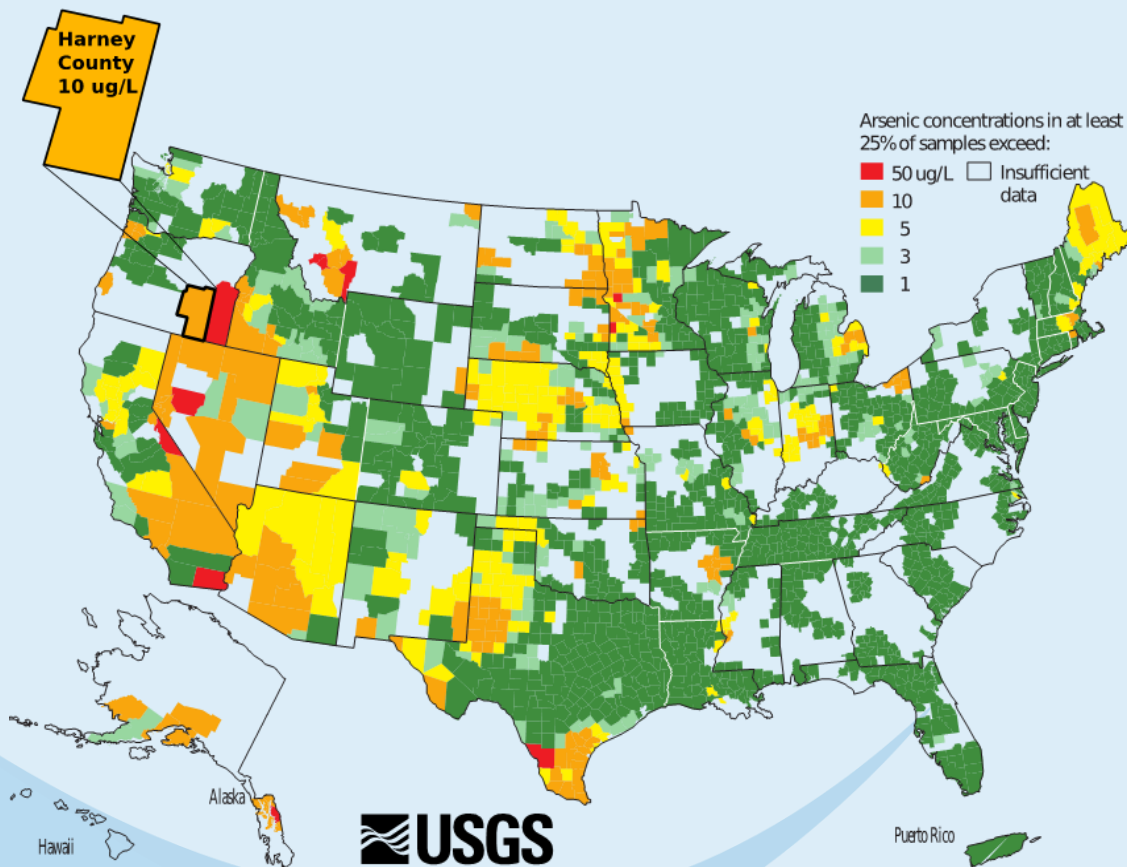
Laura Schroeder is an Oregon native, born and raised in the small agricultural area of Vale, Oregon. A respected expert in water rights, her international work includes recent missions to Afghanistan.

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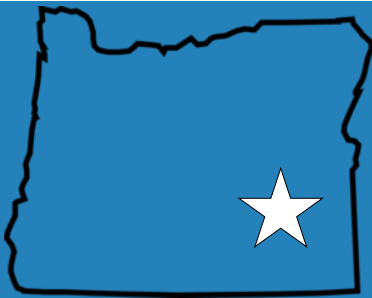
FORENSIC HYDROGEOGRAPHY: ASSESSING GROUNDWATER ARSENIC CONCENTRATIONS AND TESTING METHODS IN THE HARNEY BASIN, OREGON

Prepared by Lauren L. Smitherman, Oregon State University

Fall, 2015



(Modified from Ryker, 2001)



GROUNDWATER ARSENIC IN THE HARNEY BASIN

General Facts

What is Arsenic?

Arsenic is a naturally occurring element in the earth's crust and is found in soil, bedrock and water. Because it is an element, arsenic persists in the environment and does not deteriorate. It is odorless, colorless and tasteless.

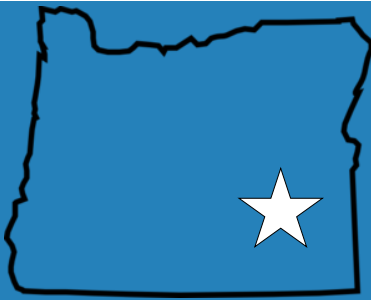
Arsenic in the environment

Arsenic and its compounds have an array of commercial uses. It is used to manufacture other metals, glass, electronic components, and wood preservatives. It is an important component of insecticides and weed killers. In the past it was used in pigments to color wallpapers, paints and ceramics. Mining, smelting and wood processing can also contribute to local arsenic burdens.

How does it get into drinking water?

The majority of arsenic exposure through drinking water is from natural geological sources rather than from mining, smelting, or agricultural sources such as pesticides and fertilizers. Some exposure may be a result of runoff from agricultural lands. Arsenic may also be found in the drinking water of homes located near waste sites where paint, pesticides or electronic components are disposed.

The drinking water standard for arsenic is 10 parts per billion (ppb). Private well owners are not required to meet the standards, but it is a health-based recommendation for short-term and long-term exposure.



GROUNDWATER ARSENIC IN THE HARNEY BASIN

The Study

Why was research conducted in the Harney Basin?

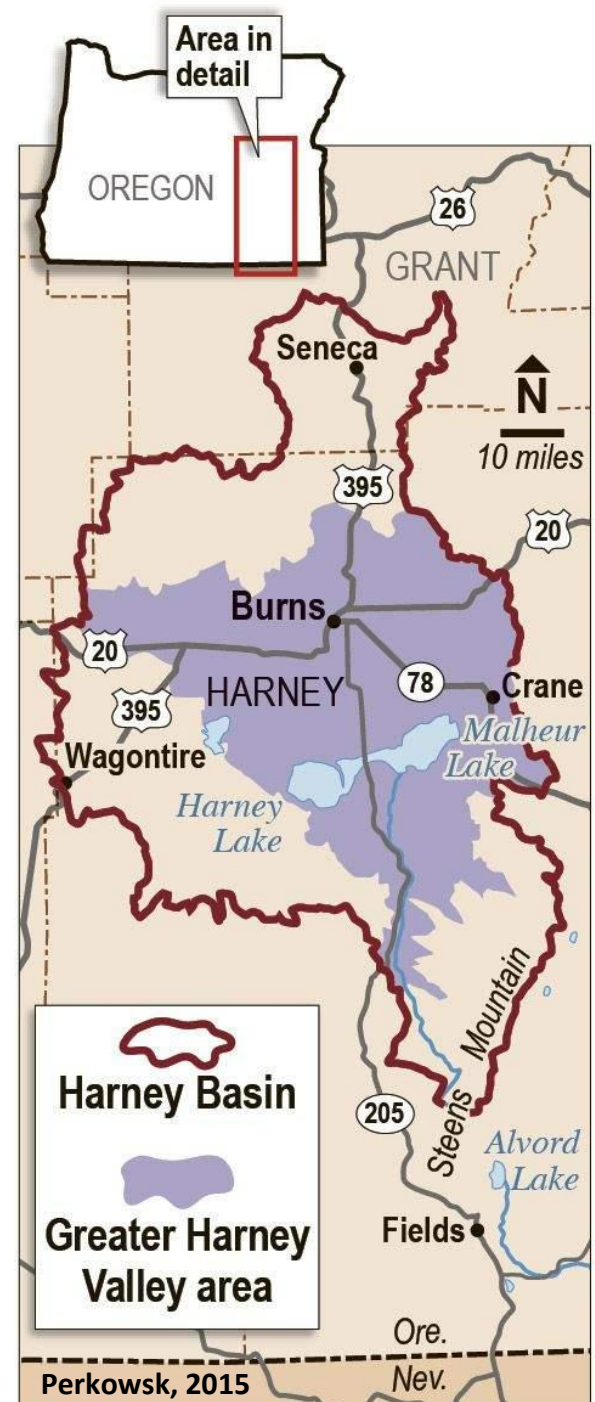
Previous geologic and hydrologic investigations were conducted in the Harney Basin that revealed high levels of arsenic in the groundwater. The tests revealed localized areas of high arsenic concentrations.

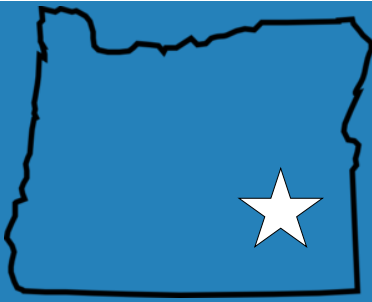
Oregon State University wanted to confirm and expand on previous arsenic sampling to determine if a relationship exists between arsenic occurrence and the geography, hydrology, and geology with the Harney Basin.

A secondary purpose of the research was to evaluate if publically-available field screening tests were as effective as laboratory analysis.

How were the samples collected and tested?

Participation in this study was voluntary and confidential. Sample collection was conducted on private and public properties. A field screening test and subsequent laboratory testing was performed.



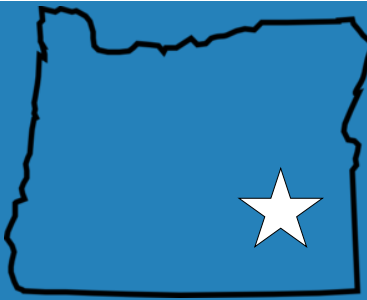


GROUNDWATER ARSENIC IN THE HARNEY BASIN

What are the aquifers in the Harney Basin?

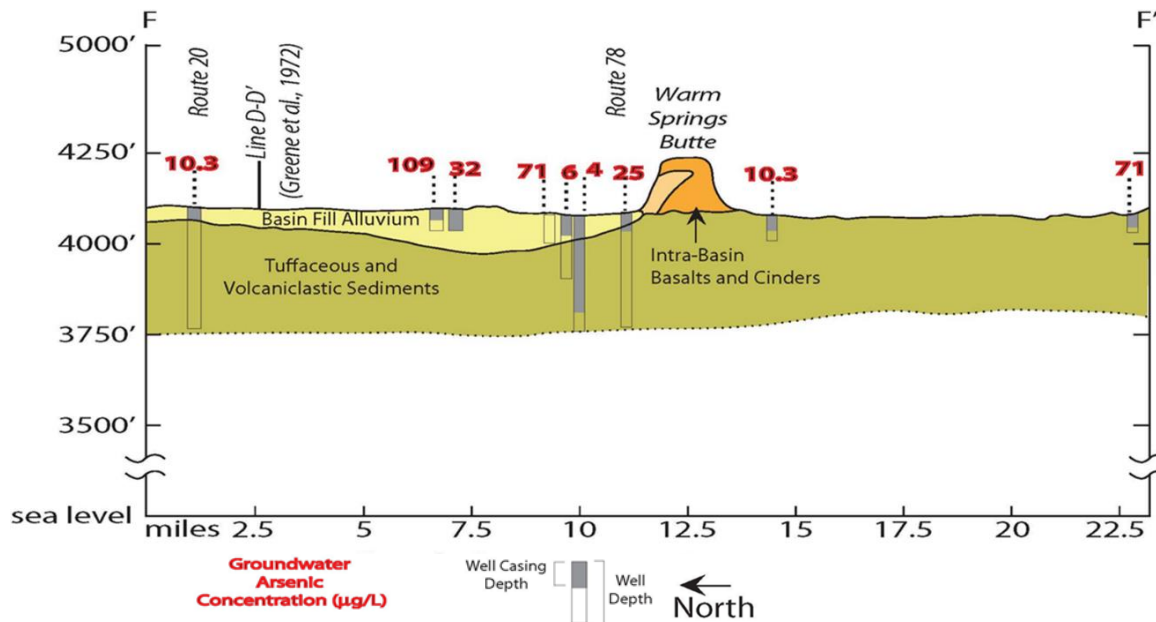
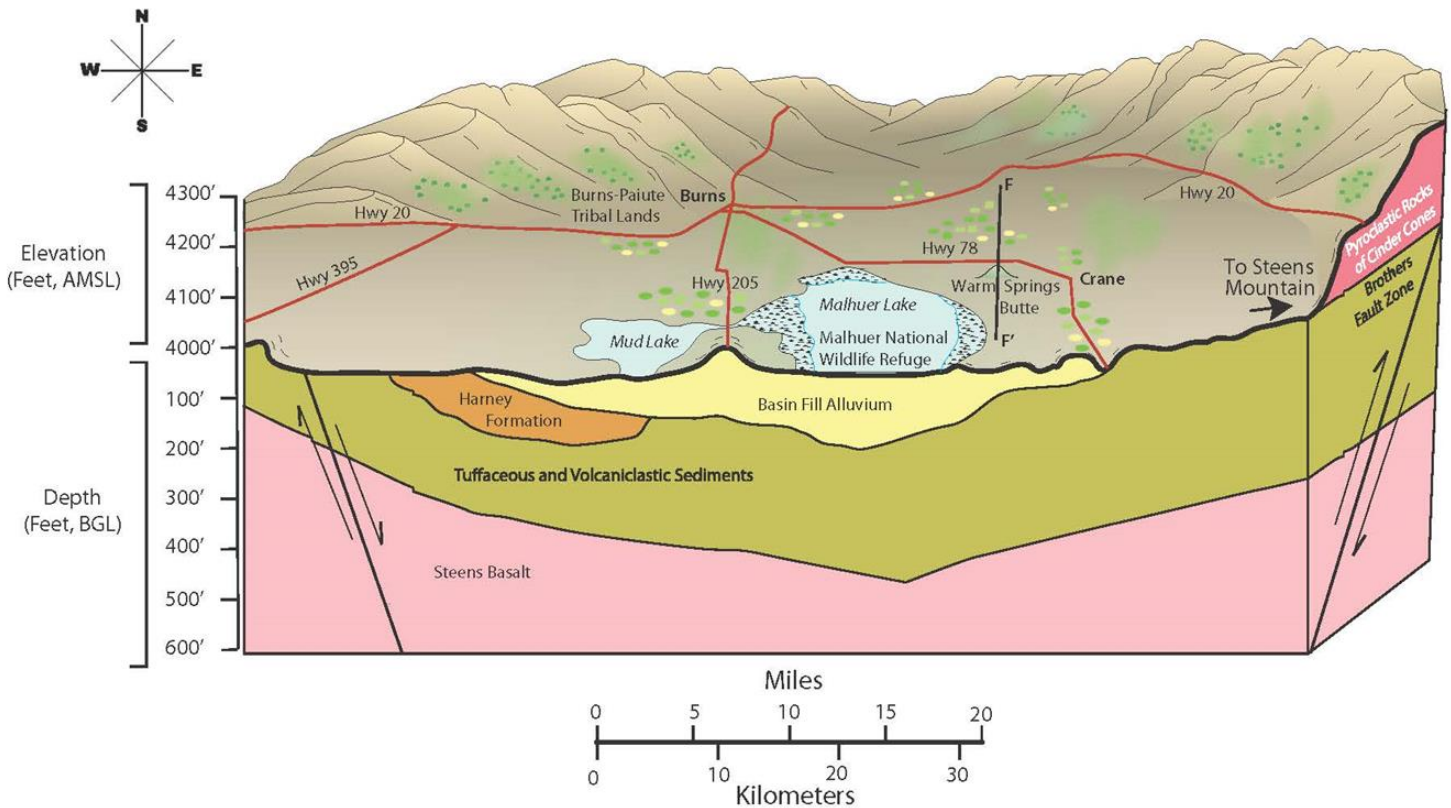
The Harney Basin has many water-bearing zones called aquifers. The rock layers (lithology) from well logs that were used to categorize the aquifers are described below.

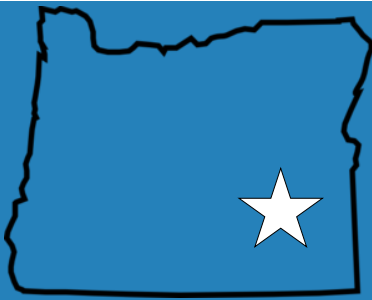
Aquifer	Lithology	Aquifer Region
Valley (Basin) Fill	Gravel, sand, silt, clay, sandy-clay, clayey-sand, gravel, and clayey-gravel	Valley floor and up the major tributary valleys
Tuffaceous and Volcaniclastic Sediments	Clay, claystone, minor sand, sandstone, pumice	Underlies Basin Fill
Diamond/Voltage Basalt, includes Mafic Vent Complexes	Lava flows, cinders, and vent complexes	Directly south of Malheur Lake
Intra-Basin Basalts and Binders	Lavas flows, pyroclastics, palagonite, cinders	West of Harney Valley and within the Harney structural basin
Harney Formation	Sandstone, claystone, conglomerate, sand and gravel	West of Harney Valley and within the Harney structural basin
Volcaniclastic Sedimentary Rocks	Rhyolitic siltstone, claystone, sandstone, conglomerate	North, east and southeast outside the structural basin
Steens Basalt	Lava Flows	North, east and southeast outside the structural basin



GROUNDWATER ARSENIC IN THE HARNEY BASIN

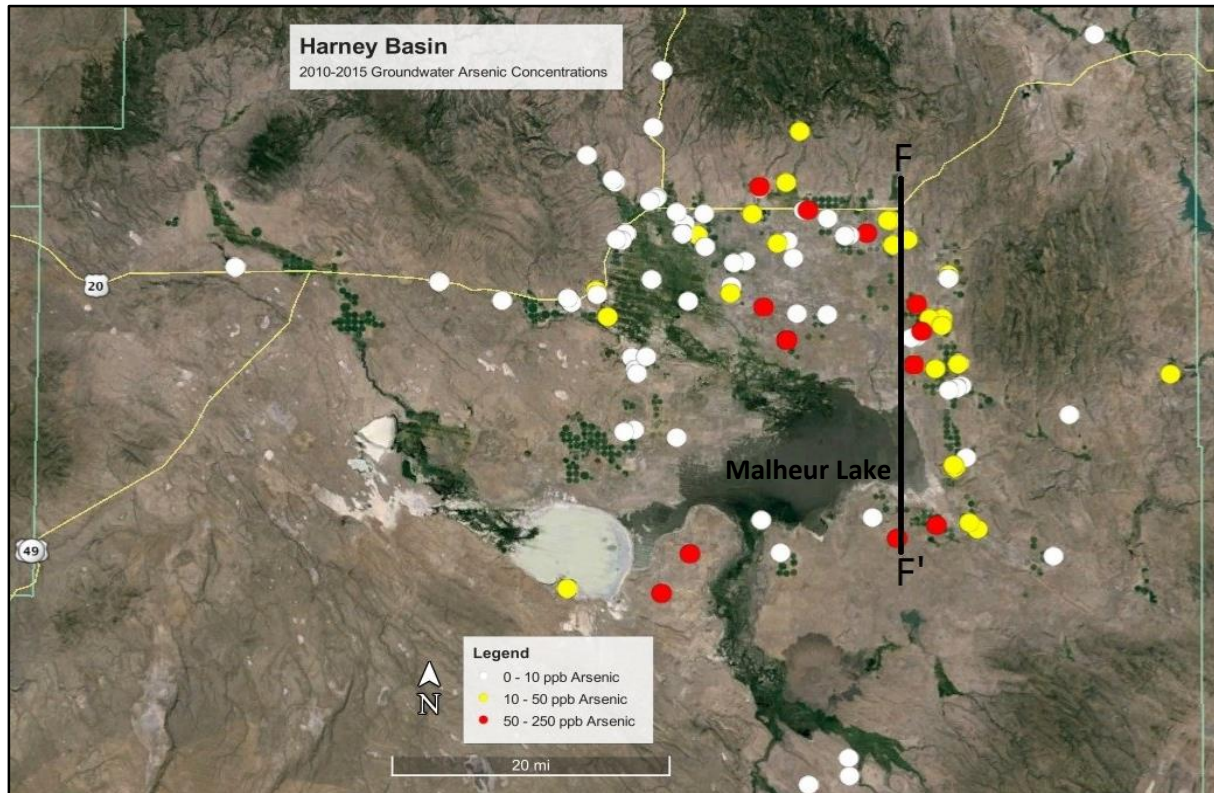
Where are the aquifers in the Harney Basin?





GROUNDWATER ARSENIC IN THE HARNEY BASIN

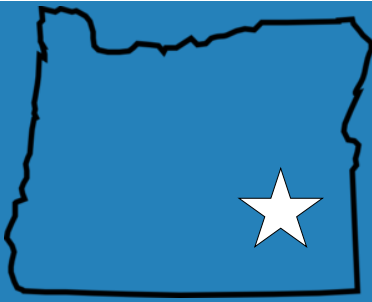
Where was arsenic found in the Harney Basin?



A total of 49 samples were collected across the basin and 91 prior arsenic values were incorporated into the analysis. Of the 140 samples, 68% were below 10 ppb; 21% of the samples were between 10 and 50 ppb; and 11% of the groundwater contained above 50 ppb.

While the Tuffaceous and Volcaniclastic Sediment Aquifer is the most likely to contain arsenic levels above the MCL, it was found that **all aquifers in the Harney Basin contain arsenic**. While some aquifers contain higher concentrations of arsenic than others, there is not one that is responsible for the extremely high levels found in some wells.

All residents must test their well water to confirm the presence of arsenic.



GROUNDWATER ARSENIC IN THE HARNEY BASIN

How do I test my well water? Field Screening Kit or Laboratory Test?

Many water quality tests are available for public purchase. However, the accuracy of the 49 tests fluctuated in precision. The tests may be useful as a general tool for determining the presence of arsenic, but not the quantity.

The field tests only screen for one type of arsenic (inorganic), generally more prevalent in groundwater. Industry standard tests, such as ICP-MS analysis, tests for total arsenic (organic + inorganic). A 2015 study through the University of Oregon (Maguffin, 2015) indicates arsenic can cycle through forms in aquifers and is highly dependent on the pH and other geochemical factors.

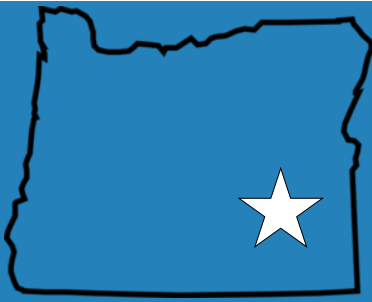
It is advised to send samples to an accredited laboratory for total arsenic analysis.

Find an accredited laboratory that does water testing for private property owners. These labs can provide information and instructions on collecting well water samples and will often provide a container.

For a list of accredited laboratories in Oregon - call the Oregon Environmental Laboratory Accreditation Program (ORELAP) at 503-693-4122 or visit:

<http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Documents/acclab.pdf>

Children are more susceptible to all environmental chemicals, including arsenic due to their greater water consumption on per unit body weight basis and the fact that their bodies are still developing. Therefore, it is usually recommended that additional efforts should be made to **identify** and **reduce** children's exposure to arsenic. Pregnant women should also reduce their exposure to arsenic because it can cross the placental barrier which leads to risks for the fetus.



GROUNDWATER ARSENIC IN THE HARNEY BASIN

NOTES



From the Bottom Up: Groundwater Engineering and Citizen Collaboration for Stormwater Solutions in Falls City, OR



Joseph B. Kemper

Water Resources Graduate Program, Oregon State University, Corvallis, OR United States

Groundwater Flooding In Falls City

Neighborhoods in south Falls City, OR battle heavy stormwater discharge during wet Coast Range winters. Most mitigation efforts have focused on individual surface runoff diversions leading to disagreements between upstream and downstream landowners. This study aims to investigate the contribution of groundwater to the surface flooding in south Falls City and to determine the feasibility of various dewatering schemes to mitigate stormwater flooding.

RESEARCH QUESTIONS:

- 1.) Is groundwater a primary driver of surface flooding in high precipitation alluvial basins?
- 2.) What combination of engineering solutions for flood mitigation is most feasible for small rural communities?



Figure 1. South Falls City Flooding Situation Location Map. This map was produced by Falls City residents during Community Watershed Forum Meetings and refined later by Professor Todd Jarvis. The Figure features potential solutions generated by Falls City residents in Meetings.

Groundwater Flooding

- Occurs when water table intersects ground surface.
- Long seasonal onset as water table rises from dry to wet season.
- Often accompanies and exacerbates surface/fluvial flooding.
- Longer subsidence time than surface flooding.
- Recently recognized as source of surface ponding in many locations:
 - Lincoln, ND, Denver, CO, Twin Cities, MN, Alberta, Canada, Karst regions of UK

Methods

- Geologic characterization of setting: mapping, geotechnical boring, seismic refraction survey.
- Characterization of hydraulic properties of subsurface: pump and slug testing.
- Gathering local knowledge about watershed change and hydrology.
- Conduct interviews with landowners in south Falls City to characterize flooding variation across flooding zone.

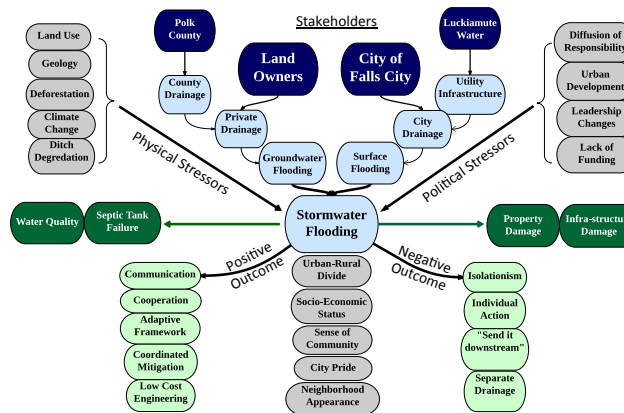


Figure 2. Conflict Map of Falls City Stormwater Dispute. Outlines stakeholders, infrastructure, influences (physical, political, and interpersonal), results, and actions.

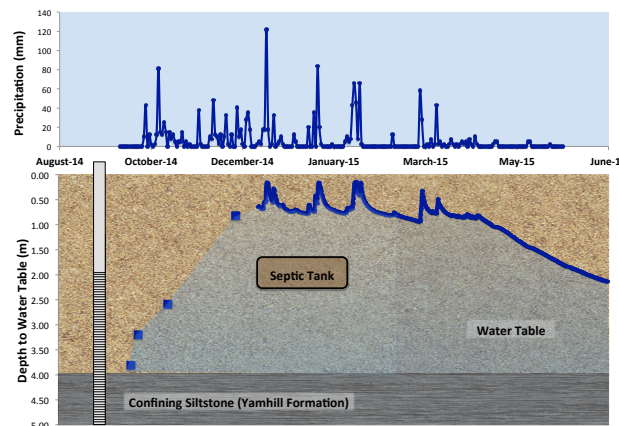


Figure 3. Seasonal Water Table Fluctuation. Precipitation recorded at NOAA gage #352800 in Falls City, OR. Water table measurements recorded at monitoring well (Fig 1.) with a hand operated well sounder until pressure transducers were installed on 12/15/2014..

Community Collaboration

In addition to aquifer characterization and mitigation evaluation, this study also aims to facilitate collaboration between stakeholders. Historically, landowners have constructed simple drainage measures individually without consulting neighbors, which increases discharge to downstream stakeholders. Beginning in 2013, IWV has sponsored Community Watershed Forum meetings that bring stakeholders together to explore solutions. This study's dewatering analysis will aim to supplement stakeholder generated solutions in future meetings to arrive at consensus on a mitigation plan. Lastly, the study aims to put in place an adaptive framework for stakeholders to maneuver through future disputes.

Dewatering Methods

	Proposed Solution	Pros	Cons	Estimated Cost
Footprint and Maintenance Expense	Ditch Maintenance	Low Cost, Cooperative, Uses Existing Infrastructure	Shallow Dewatering Potential, Frequent Maintenance	\$0 to \$500
	Reforestation	Neighborhood Aesthetics, Retards Flooding	Long Lead Time, Finite Dewatering Potential	Local: \$50 to \$500; Basin: \$1,000 to \$5,000
	Ditch Excavation	High Drainage Potential, Large Capture Area	Deep Ditch Required, Frequent Maintenance	1 ft depth: \$1,500; 3 ft depth: \$10,000 to \$25,000
	Drain Tiles	High Drainage Potential, Limited Surface Disruption	Many Lines Needed, Excavation Installation, Limited by Topography	\$2,500 to \$10,000 per parcel
	Dewatering Wells	Small Surface Footprint, Deepest Dewatering Potential	Requires Power, Vulnerable to Mechanical Failure, Many Wells Required	\$10,000 per well

Next Steps

- Seismic refraction to determine depth of alluvium for entire flooding zone.
- Measurement of volumetric flow in ditches at various groundwater levels.
- Infiltration data from region's septic tanks to evaluate subsurface heterogeneity.
- Tracer test to evaluate connectivity of subsurface to ditches.
- LIDAR data to determine possible drainage diversion and paleo-river channels.
- Pre-engineering, modeling and pricing of proposed mitigation measures.
- Continue sponsoring stakeholder meetings to coordinate solutions.

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Acknowledgements

Todd Jarvis, the Institute for Water and Watersheds, the City of Falls City, Bill Mann of In Situ, Inc., Jake Howell of West Coast Well Drilling, Marvin and Scott Van Horn, Tracy Young, Vicki Avery and all of the citizens of Falls City.

USGS Summer Intern Program

None.

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	1	1	0	0	2
Masters	4	0	0	0	4
Ph.D.	0	0	0	0	0
Post-Doc.	2	0	0	0	2
Total	7	1	0	0	8

Notable Awards and Achievements

Federal Relations Director Gabrielle Serra, IWW Director Todd Jarvis, and National Science Foundation-funded **Willamette Water 2100** Principal Investigator Roy Haggerty meet with Congresswoman Bonamici on April 2, 2015 at her invitation for an update on water situation in Congressional District No. 1.

Architects proposing on Willamette Falls Legacy Project contact IWW Director Todd Jarvis for redevelopment concepts following a water theme. Proposal submitted for the **Oregon Water Institute** – a research, teaching, and small industry manufacturing center integrating PSU, OIT, UO, and OSU. Concept submitted for consideration during the **White House Summit on Water** (https://gallery.mailchimp.com/32faec97510a9e9b00eec116d/files/Oregon_Water_Institute.pptx.pdf).

IWW Director Todd Jarvis interviewed by *Oregon Business Magazine* about a proposed bottled water plant in the Columbia River Gorge (<http://www.oregonbusiness.com/article/the-magazine/june-2015/item/15049-frothy-battle>)

Research on **green algae blooms** funded by both USGS 104(b) and 104(g) grants profiled in *The Oregonian* newspaper (http://www.oregonlive.com/environment/index.ssf/2015/06/algae_blooms_can_travel_in_run.html)

The International Association of Hydrogeologists US Chapter has designated a new **international service award**. IWW nominated Oregon State hydrologist Michael Campana as the first awardee. He received the award at the 2015 Geological Society of America Annual Meeting in November.

Oregon State Water Resources Engineering graduate student Joe Kemper was featured in the most recent edition of Oregon State's *Terra Magazine*, which highlights faculty and student research efforts throughout the university. Kemper's research involves using engineered solutions to mediate water conflict in Falls City, a community located in Polk County, Oregon and was funded in part through the USGS 104(b) base grant (https://gallery.mailchimp.com/32faec97510a9e9b00eec116d/files/Stormy_Waters.pdf). **Kemper awarded the Williamson Water Prize for leadership in the OSU Water Resources Graduate Program**

In a recent article from *Terra Magazine*, OSU's official research publication, Water Resources Science graduate student Lauren Smitherman's research regarding arsenic in water supply is highlighted. Smitherman focused her work on the rural regions of Oregon, with the goal of evaluating the validity of over-the-counter arsenic detection kits. Smitherman's research funded in part from a bequest to IWW from an eastern Oregon rancher (<http://oregonstate.edu/terra/2015/10/arsenic-in-rural-oregon/>).

Aaron Wolf of Oregon State University wins the **Gilbert White Public Service Award** from the American Association of Geographers.

IWW Premieres "Stormwater Solutions", a film highlighting the creation of the **OSU-Benton Country Green Stormwater Infrastructure Facility, an Oregon BEST Lab (OSGIR)** and funded in part using USGS 104(b) funds. **Stormwater Solutions** is the first in an ongoing IWW effort to highlight student and faculty water research through visual media. The IWW plans to create and release at least one film of this nature per year (https://media.oregonstate.edu/media/t/0_03knf8eg)

IWW co-hosts **Cynthia Lodge, Associate Director of Office of Budget, Planning, and Integration** of the USGS with the Oregon Water Science Center for tour of Willamette Falls.